ASSESSING SEISMIC HAZARD IN PUERTO RICO AND THE VIRGIN ISLANDS USING THE HISTORICAL EARTHQUAKE RECORD AND MIXED-MODE GPS GEODESY: COLLABORATIVE RESEARCH BETWEEN THE UNIVERSITY OF PUERTO RICO-MAYAGUEZ AND THE UNIVERSITY OF TEXAS AT EL PASO

Diane I. Doser
University of Texas at El Paso
Department of Geological Sciences, 500 W. University Avenue, El Paso, TX 79968
(915)-747-5851, (915)-747-5073, doser@geo.utep.edu

TECHNICAL ABSTRACT:
We have collected and modeled the seismograms of historic earthquakes of M>6.0 occurring in the Puerto Rico and Virgin Islands region between 1915 and 1963, as well as compiling source parameter information for recent (post-1962) earthquakes within the region. Study of offshore events north and west of Puerto Rico indicate rupture along the North American plate interface in 1920 (M_w=6.5) and 1943 (M_w=7.8 and 6.0) at depths of 24 to 29 km. An event in 1915 (M_w=6.7) appears to be related to reverse faulting within the Greater Antilles crust above the plate interface (15 km), while an event in 1917 (M_w =6.9) involved strike-slip faulting within the subducting North American plate (36 km). The 1918 Mona Canyon earthquake (M_w=7.2) represents normal faulting at ~20 km depth. This earthquake generated a tsunami that killed over 100 people on the island of Puerto Rico. The event has a complex source-time function, suggesting rupture along several fault segments. This is consistent with previous tsunami modeling studies. An event in 1916 in southeastern Hispaniola (M_w=6.8) occurred at a depth of ~16 km with a reverse faulting mechanism similar to aftershocks of the 1946 great Hispaniola earthquake. Within the Virgin Islands region we studied three moderate (M 6-6.5) events. Their smaller size made collection and modeling of seismograms more difficult. For one event (1927) we were only able to make forward modeling comparisons between our limited seismic data and the focal mechanisms of recent events in the vicinity of the older events. Two of the events (1919 and 1930, M_w=6.2 and 6.0) appear to involve faulting within the subducting North American plate, while an event in 1927 (M_w=5.6) may have involved rupture along the plate interface. An event in 1939 (M_w=6.4) located well to the north of the Puerto Rico trench is consistent with normal faulting within the outer rise. Slip vectors for historic and recent events in the Virgin Islands region suggest southwest to west-southwest directed slip. Northwest of Puerto Rico slip is directed south-southwest, rotating to southeastward directed slip south of the offshore extension of the Septentrional fault zone. The change in slip vector direction between the Virgin Islands and Puerto Rico is consistent with GPS results that suggest a difference in relative motion between Puerto Rico and the Virgin Islands.

NON-TECHNICAL ABSTRACT

ASSESSING SEISMIC HAZARD IN PUERTO RICO AND THE VIRGIN ISLANDS USING THE HISTORICAL EARTHQUAKE RECORD AND MIXED-MODE GPS GEODESY: COLLABORATIVE RESEARCH BETWEEN THE UNIVERSITY OF PUERTO RICO-MAYAGUEZ AND THE UNIVERSITY OF TEXAS AT EL PASO

Award Number: 00HQGR0013

Diane I. Doser
University of Texas at El Paso
Department of Geological Sciences, 500 W. University Avenue, El Paso, TX 79968
(915)-747-5851, (915)-747-5073, doser@geo.utep.edu

All magnitude >6.0 earthquakes in the Puerto Rico-Virgin Islands region occurred prior to 1945; thus little is known about the structures that caused these earthquakes. Our study addressed this lack of knowledge by collecting and modeling seismograms of these earthquakes to determine their depths and causative faults. The results will be integrated with global positioning satellite (GPS) measurements of crustal motion to determine the rate and style of seismic versus non-seismic regional deformation. This information will provide important new constraints for regional seismic hazard maps and building/infrastructure design.